IV. *On the Nature of the Diamond. By* Smithson Tennant, *Esq. F. R. S.*

Read December 15, 1796.

SIR ISAAC NEWTON having observed that inflammable bodies had a greater refraction, in proportion to their density, than other bodies, and that the diamond resembled them in this property, was induced to conjecture that the diamond itself was of an inflammable nature. The inflammable substances which he employed were camphire, oil of turpentine, oil of olives, and amber; these he called "fat, sulphureous, unctuous "bodies;" and using the same expression respecting the diamond, he says, it is probably "an unctuous body coagulated." This remarkable conjecture of Sir ISAAC NEWTON has been since confirmed by repeated experiments. It was found that, though the diamond was capable of resisting the effects of a violent heat when the air was carefully excluded, yet that on being exposed to the action of heat and air, it might be entirely consumed. But as the sole object of these experiments was to ascertain the inflammable nature of the diamond, no attention was paid to the products afforded by its combustion; and it still therefore remained to be determined whether the diamond was a distinct substance, or one of the known inflammable bodies. Nor was any attempt made to decide this question till M. LAVOISIER, in 1772, undertook a series of

experiments for this purpose. He exposed the diamond to the heat produced by a large lens, and was thus enabled to burn it in close glass vessels. He observed that the air in which the inflammation had taken place had become partly soluble in water, and precipitated from lime-water a white powder which appeared to be chalk, being soluble in acids with effervescence. As M. LAVOISIER seems to have had little doubt that this precipitation was occasioned by the production of fixed air, similar to that which is afforded by calcareous substances, he might, as we know at present, have inferred that the diamond contained charcoal; but the relation between that substance and fixed air, was then too imperfectly understood to justify this conclusion. Though he observed the resemblance of charcoal to the diamond, yet he thought that nothing more could be reasonably deduced from their analogy, than that each of those substances belonged to the class of inflammable bodies.

As the nature of the diamond is so extremely singular, it seemed deserving of further examination; and it will appear from the following experiments, that it consists entirely of charcoal, differing from the usual state of that substance only by its crystallized form. From the extreme hardness of the diamond, a stronger degree of heat is required to inflame it, when exposed merely to air, than can easily be applied in close vessels, except by means of a strong burning lens; but with nitre its combustion may be effected in a moderate heat. To expose it to the action of heated nitre free from extraneous matters, I procured a tube of gold, which by having one end closed might serve the purpose of a retort, a glass tube being adapted to the open end for collecting the air produced. To be certain that the gold vessel was perfectly closed,

and that it did not contain any unperceived impurities which could occasion the production of fixed air, some nitre was heated in it till it had become alkaline, and afterwards dissolved out by water; but the solution was perfectly free from fixed air, as it did not affect the transparency of lime-water. When the diamond was destroyed in the gold vessel by nitre, the substance which remained precipitated lime from lime-water, and with acids afforded nitrous and fixed air; and it appeared solely to consist of nitre partly decomposed, and of aerated alkali.

In order to estimate the quantity of fixed air which might be obtained from a given weight of diamonds, two grains and a half of small diamonds were weighed with great accuracy, and being put into the tube with a quarter of an ounce of nitre, were kept in a strong red heat for about an hour and a half. The heat being gradually increased, the nitre was in some degree rendered alkaline before the diamond began to be inflamed, by which means almost all the fixed air was retained by the alkali of the nitre. The air which came over was produced by the decomposition of the nitre, and contained so little fixed air as to occasion only a very slight precipitation from lime-water. After the tube had grown cold, the alkaline matter contained in it was dissolved in water, and the whole of the diamonds were found to have been destroyed. As an acid would disengage nitrous air from this solution as well as the fixed air, the quantity of the latter could not in that manner be accurately determined. To obviate this inconvenience, the fixed air was made to unite with calcareous earth, by pouring into the alkaline solution a sufficient quantity of a saturated solution of marble in marine acid. The vessel which contained

them being closed, was left undisturbed till the precipitate had fallen to the bottom, the solution having been previously heated that it might subside more perfectly. The clear liquor being found, by means of lime-water, to be quite free from fixed air, was carefully poured off from the calcareous precipitate.* The vessel which was used on this occasion was a glass globe, having a tube annexed to it, that the quantity of the fixed air might be more accurately measured. After as much quick-silver had been poured into the glass globe containing the calcareous precipitate as was necessary to fill it, it was inverted in a vessel of the same fluid. Some marine acid being then made to pass up into it, the fixed air was expelled from the calcareous earth; and in this experiment, in which two grains and a half of diamonds had been employed, occupied the space of a little more than 10.1 ounces of water.

The temperature of the room when the air was measured, was at 55°, and the barometer stood at about 29.8 inches.

From another experiment made in a similar manner with one grain and a half of diamonds, the air which was obtained occupied the space of 6.18 ounces of water, according to which proportion the bulk of the fixed air from two grains and a half would have been equal to 10.3 ounces.

The quantity of fixed air which was thus produced by the diamond, does not differ much from that which, according to M. LAVOISIER, might be obtained from an equal weight of charcoal. In the Memoirs of the French Academy of Sciences for

* If much water had remained, a considerable portion of the fixed air would have been absorbed by it. But by the same method as that described above, I observed, that as much fixed air might be obtained from a solution of mineral alkali, as by adding an acid to an equal quantity of the same kind of alkali.

the year 1781, he has related the various experiments which he made to ascertain the proportion of charcoal and oxygen in fixed air. From those which he considered as most accurate, he concluded that 100 parts of fixed air contain nearly 28 parts of charcoal and 72 of oxygen. He estimates the weight of a cubic inch of fixed air under the pressure and in the temperature abovementioned, to be .695 parts of a grain. If we reduce the French weights and measures to English, and then compute how much fixed air, according to this proportion, two grains and a half of charcoal would produce, we shall find that it ought to occupy very nearly the bulk of 10 ounces of water.

M. Lavoisier seems to have thought that the aerial fluid produced by the combustion of the diamond was not so soluble in water as that procured from calcareous substances. From its resemblance, however, in various properties, hardly any doubt could remain that it consisted of the same ingredients; and I found, upon combining it with lime, and exposing it to heat with phosphorus, that it afforded charcoal in the same manner as any other calcareous substance.